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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/553,997	04/20/2000	Douglas A. Buchanan	13322(YOR92600-0036US1)	5913

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EXAMINER

VOCKRODT, JEFF B

ART UNIT	PAPER NUMBER
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2822

DATE MAILED: 10/20/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/553,997

Applicant(s)

BUCHANAN ET AL.

Examiner

Jeff Vockrodt

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 July 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4-12 and 14-22, 24-57 is/are pending in the application.

4a) Of the above claim(s) 4-12 is/are withdrawn from consideration.

- 5) ☐ Claim(s) _____ is/are allowed.

- 6) ☒ Claim(s) 1,2,14-22 and 24-57 is/are rejected.

- 7) ☐ Claim(s) _____ is/are objected to.

- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

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DETAILED ACTION

This office action is in response to the amendment filed on July 7, 2003. Claims 1-2, 4-12, 14-22, 24-57 are pending, claims 4-12 are withdrawn from consideration under 37 CFR 1.142(b). Election was made without traverse in Paper No. 10.

Objections

Specification, page 24, line 13, "trimethyl or triethyl" is unclear, these are not compounds as far as the examiner is aware.

Claim 21. "marcrocycles" is misspelled.

Claim 57. Ruthenium Carbonyl is listed correctly as $\text{Ru}_3(\text{CO})_{12}$, but is also incorrectly set forth as $\text{Ru}_3\text{CO}_{12}$.

Claim Rejections - 35 USC § 112

Multiple dependent claims 35-38 each include reference to both claim 1 and claim 24, which is not in the alternative. 35 USC 112, 5th paragraph requires that "[a] claim in multiple dependent form shall contain a reference, in the alternative only, to more than one claim previously set forth and then specify a further limitation of the subject matter claimed." (emphasis added). Accordingly, claims 35-38 are improper under 35 USC 112, 5th paragraph. Claims 35-38 are objected to under 37 CFR 1.75(c) for the same reason.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

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(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-2, 16-22, 24, 26-32 and 57 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Pat. No. 5,393,564 ("Westmoreland").

Westmoreland teaches three independently anticipating embodiments:

Westmoreland teaches CVD using an azide precursor (bis(cyclopentadienyl)titanium diazide) dissolved in an inert solvent (liquid ammonia) (col. 3, ll. 1-6).

Westmoreland teaches CVD of a halide (zirconium tetrachloride) dissolved in an inert solvent (silicon tetrachloride) (col. 3, ll. 51-56).

Westmoreland teaches tungsten carbonyl as a precursor (col. 4, ll. 26-29) and a number of solvents that "evaporate quickly and leave no contaminants in the product film (col. 4, ll. 4-16). A person of ordinary skill in the art would consider a solvent that evaporates quickly and leaves no contaminants in the product film as an inert solvent.

Claim 2. Ammonia is used in the azide precursor embodiment. Ammonia is the simplest amine.

Claims 16-22. An additive in the amount of 0% is "no more than 30% by volume."

Claim 24. Westmoreland teaches CVD. (Fig. 1)

Claim 26-32. The co-reactant is optional. See claim 24.

Claim 39. The wafer 5 is a semiconductor substrate.

Claim 57. Westmoreland teaches $ZrCl_4$ and $W(CO)_6$, each of which are listed in claim 57.

Claims 1-2, 14-22, 24-32, 40 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Pat. No. 5,449,799 ("Terfloth").

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Claims 1-2. Terfloth teaches a compound for depositing copper layers having the form: R-Cu-Ln (col. 1). Ln can be a nitrile ("alkylisonitrile", "arylisonitrile"), silyl ("organosilylisonitrile"), halide ("fluorosubstituted") (col. 2, ll. 28-32). The compound can be deposited in liquid form ("condensed phase") and can employ pentane, benzene, or tetrahydrofuran as a solvent (col. 3, ll. 39-47).

Claim 14. The precursors and solvents are the same or similar to the disclosed, and are expected to have similar properties--i.e., pentane inherently has a higher vaporization temperature than R-Cu-Ln, wherein L is nitrile, silyl, or halide.

Claim 15. Pentane is a C10 alkane.

Claims 16-22. An additive in the amount of 0% is "no more than 30% by volume."

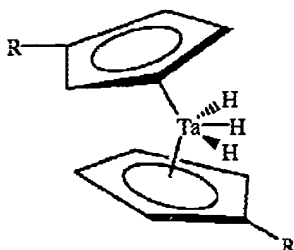
Claim 24. Terfloth teaches CVD. (Abstract).

Claims 25 and 40. Terfloth teaches conductive paths on a substrate (i.e., a wiring structure).

Claim 26-32. The co-reactant is optional. See claim 24.

Claims 1-2, 14-22, 24-32, and 39-40 are rejected under 35 U.S.C. §§ 102 (a), (e) as being anticipated by U.S. Pat. No. 6,015,917 ("Bhandari").

Claims 1-2. Bhandari teaches a tantalum cyclopentadienyl precursor compound (col. 7):



The structural formula shows three hydrogen atoms directly bonded to the Ta metal. These hydrogen atoms bonded directly to Ta represent hydride ligands. Additionally, the R groups

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include trimethylsilyl. The precursor compound may be dissolved in hexane, heptane, octane, nonane, decane, toluene, or xylene (col. 11, ll. 5-21).

Claim 14. The precursors and solvents are the same or similar to the disclosed, and are expected to have similar properties.

Claim 15. Pentane is a C10 alkane.

Claims 16-22. An additive in the amount of 0% is "no more than 30% by volume."

Claim 24. The precursors are used in CVD (col. 2, ll. 43-38) to form tantalum films..

Claim 25. The film is applied to VLSI metallization (col. 1, ll. 17-22).

Claim 26-32. The co-reactant is optional. See claim 24.

Claim 39. VLSI metallization inherently uses a semiconductor substrate.

Claim 40. VLSI metallization is a wiring structure.

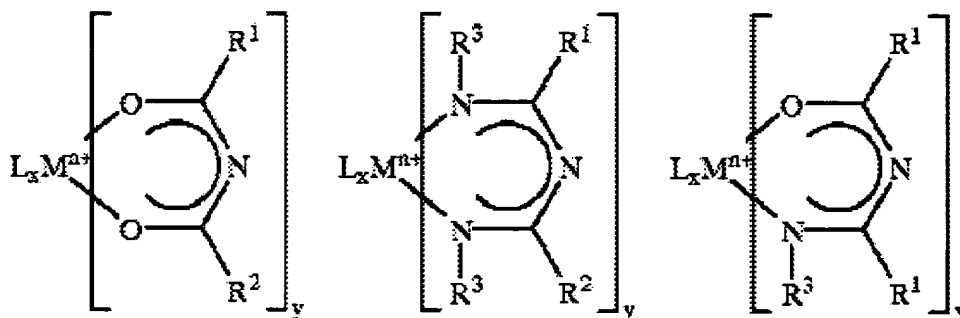
Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-2, 14-22, 24-32, 39-54, and 56 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 6,225,237 ("Vaartstra") in view of Bhandari.

Vaartstra teaches a precursor complex of the following forms (col. 5):



wherein L is, *inter alia*, a nitrile or carbonyl ligand (col. 6, ll. 12, 14-16). Additionally, the precursor composition includes one or more organic solvents suitable for use in a chemical vapor deposition system (col. 7, ll. 25-27).

The only difference between claim 1 and Vaartstra is the "inert liquid" limitation. Vaartstra teaches a solvent which contains the claimed precursor, but does not state what the solvent is or whether it is an inert solvent. Any solvent suitable for delivering a precursor in CVD would meet applicant's broad (see dependent claim 2) definition of "inert." However, Bhandari is cited, in an abundance of caution, to show that, in the event that the solvent of Vaartstra are not inherently inert, that it would have been obvious to use either hexane, heptane, octane, nonane, decane, toluene, or xylene (all inert solvents) as taught by Bhandari. It would have been obvious to one of ordinary skill in the art at the time of the invention to utilize hexane, heptane, octane, nonane, decane, toluene, or xylene as inert solvents in conjunction with the precursors taught by Vaartstra and Uhlenbrock since these solvents were well known and desirable for delivery of precursors in CVD as taught by Bhandari.

Claim 2. Bhandari teaches the claimed solvents.

Claim 14. The precursors and solvents are the same or similar to the disclosed, and are expected to have similar properties.

Claim 15. Pentane is a C10 alkane.

Claims 16-22. An additive in the amount of 0% is "no more than 30% by volume."

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Claim 24. The precursors are used in CVD (col. 2, ll. 43-38) to form tantalum films..

Claim 25. The film is applied to VLSI metallization (col. 1, ll. 17-22).

Claim 26-32. The co-reactant is optional. See claim 24.

Claim 39. Vaartstra teaches a silicon substrate (16).

Claims 25 and 40. Vaartstra teaches a number of devices including a capacitor (Fig. 1) and a transistor with contacts (Fig. 2).

Claims 41-48. Vaartstra teaches a capacitor (Fig. 1) having a bottom electrode (13), a dielectric layer (11), a top electrode (12). Claim 42. The dielectric barrier is optional. Claim 43. The dielectric is ferroelectric. Claim 44. The plug appears to be optional. Claim 45. The conductive barrier is optional. Claim 46. The bottom electrode can be Pt. Claim 47. The dielectric can be Ba, Sr, Ti type materials (col. 3, ll. 43-48). Claim 48. The top electrode can be Pt.

Claims 49-52. Vaartstra teaches a wiring structure comprising etched trenches in a dielectric layer (28) and wiring material (38). Claim 50. The dielectric 28 is oxide. Claim 51. The barrier is optional, see claim 49. Claim 52. The wiring material can be Ti.

Claims 53-54 and 56. Vaartstra teaches a substrate (16) having source (20) and drain (22) with a channel therebetween, a gate dielectric (silicon dioxide 26), and a gate electrode (24); the precursor is applied to form layer 24. Claim 54. The gate insulator is silicon dioxide. Claim 56. The gate electrode can be Ti.

Claims 33-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Vaartstra and Bhandari as applied to claims 1-2, 14-22, 24-32, 39-54, and 56 above, further in view of U.S. Pat. No. 5,879,459 ("Gadgil").

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Vaartstra and Bhandari teaches a precursor mixture for depositing films, some of which can be AB type dielectric films. Vaartstra does not teach sequentially pulsing precursor, purge gas, and co-reactant into the CVD chamber.

Gadgil teaches a pulse pattern for depositing an AB type material from precursor gases Ax and By respectively. See Figs. 1a-1b. One cycle incorporates one pulse of Ax and one pulse of By, each precursor pulse separated by a pulse of purge gas. Col. 3, ll. 29-37. This sequence avoids reactions between the precursors. Col. 3, ll. 50-55.

It would have been obvious to one of ordinary skill in the art at the time of the invention to pulse the A and B components with intervening purge gas pulses in the deposition of the SBT layer of Vaartstra and Bhandari, because this configuration avoids reactions between the precursors as taught by Gadgil.

Claim 55 is rejected under 35 U.S.C. 103(a) as being unpatentable over Vaartstra and Bhandari as applied to claims 1-2, 14-22, 24-32, 39-54, and 56 above, further in view of U.S. Pat. No. 5,668,028 ("Bryant").

Vaartstra and Bhandari teach a precursor mixture and forming a gate dielectric (26, Fig. 2) made of silicon dioxide. Claim 55 requires a gate dielectric composed of more than one layer.

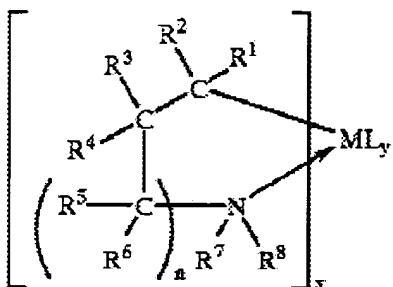
Bryant teaches a gate oxide layer having a thin nitride layer overlying the oxide layer just under the gate conductor. The nitride layer prevents asperities on the underside of the gate conductor during reoxidation of the transistor.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a two-layer NO gate insulating layer in the device taught by Vaartstra to reduce the formation of asperities on the underside of the gate conductor as taught by Bryant.

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Claims 1-2, 14-22, 24-32, and 39-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 6,214,729 ("Uhlenbrock") in view of Bhandari.

Uhlenbrock teaches a precursor complex of the following form (col. 5):



wherein L is, *inter alia*, a hydride ("H"), a silyl ("silylated(C1-C30)hydrocarbyl"), or a halide (col. 6, ll. 50-56). Additionally, the precursor composition can be a solid that is soluble in a suitable solvent that is not detrimental to the substrate (col. 8, ll. 16-18).

The only difference between claim 1 and Uhlenbrock is the "inert liquid" limitation. Uhlenbrock teaches a solvent which contains the claimed precursor, but does not state what the solvent is or whether it is an inert solvent. Any solvent suitable for delivering a precursor in CVD would meet applicant's broad (see dependent claim 2) definition of "inert." However, Bhandari is cited, in an abundance of caution, to show that, in the event that the solvent of Uhlenbrock is not inherently inert, that it would have been obvious to use either hexane, heptane, octane, nonane, decane, toluene, or xylene (all inert solvents) as taught by Bhandari. It would have been obvious to one of ordinary skill in the art at the time of the invention to utilize hexane, heptane, octane, nonane, decane, toluene, or xylene as inert solvents in conjunction with the precursors taught by Uhlenbrock since these solvents were well known and desirable for delivery of precursors in CVD as taught by Bhandari.

Response to Arguments

Applicant's arguments with respect to claim 1-2, 14-22, 24-57 have been considered but are moot in view of the new ground(s) of rejection.

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Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning communications from the examiner should be directed to Jeff Vockrodt at (703) 306-9144 who can be reached on weekdays from 9:30 am to 5:00 pm EST. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian, can be reached at (703) 308-4905.

The fax numbers for this Group are (703) 305-3432, (703) 308-7722, (703) 305-3431, and (703) 308-7724. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist at (703) 308-0956.

October 1, 2003

J. Vockrodt



AMIR ZARABIAN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800